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ABSTRACT

This study examined differences in student achievement on the 2000 National Assessment of Educational Progress (NAEP) mathematics test by their teachers' years-of-experience teaching mathematics. Data examined were mean scale scores or and eighth grade national, national public school students, and eighth grade Kentucky, Tennessee, and Texas public school students. These states were chosen because of their statewide systematic school reform efforts. The research question was: Are mathematics scores of students of more experienced mathematics teachers higher than those of students of less experienced teachers? The NAEP data include "years of teaching mathematics experience" with five categories: 2 years or less, 3-5 years, 8-10 years, 11-24 years, and 25 years or more. The NAEP Data Tool was used to create descriptive tables of mean scale scores across categories and to test for statistically significant differences. Effect size was calculated by the researcher. Although statistically significant differences in eighth grade scores in national, national public, Kentucky, and Texas data indicated that the students of teachers with more years of experience teaching mathematics had higher mathematics scores on the eighth grade NAEP mathematics test, the effect sizes were small (ranging from 0.08 to 0.37). (Contains 11 tables and 10 references.) (Author/SLD)

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ED 471 550

Running Head: THE RELATIONSHIP BETWEEN TEACHERS'

# The Relationship Between Teachers' Years-of-Teaching Experience and Students' Mathematics Achievement

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Abstract

This study examined differences in student achievement on the 2000 National Assessment of Educational Progress (NAEP) Mathematics Test by their teachers' years-of-experience teaching mathematics. Data examined were mean scale scores of and eighth grade national, national public school students, and eighth grade Kentucky, Tennessee and Texas public school students. These states were chosen because of their statewide systematic school reform efforts. The research question was: Are mathematics scores of students of more experienced mathematics teachers higher than those of students of less experienced teachers? The National Assessment of Educational Progress data include "years-of-teaching-mathematics-experience" with five categories: 2 years or less, 3-5 years, 8-10 years, 11-24 years, and 25 years or more. The NAEP Data Tool was used to create descriptive tables of mean scale scores across categories and to test for statistically significant differences. Effect size was calculated by the researcher. Although statistically significant differences ($p<.01$) in eighth grade scores in national, national public, Kentucky, and Texas data indicated that the students of teachers with more years of experience teaching mathematics had higher mathematics scores on the eighth grade NAEP Mathematics Test, the effect sizes were small (ranging from .08 to .37).

The Relationship Between Teachers' Years-of-Teaching Experience and Students' Mathematics Achievement

Teaching is one of the few professions in which the professionals are assumed to be able to exhibit excellence the first year on the job. Public school teaching appears to be easy. Most American adults have spent long hours--as students--observing teachers teach. Yet, there is research evidence that experience counts. This evidence comes with the concomitant implication that effective teaching strategies are learned on the job.

Research studies examining the teacher characteristic "years-of-teaching-experience" are plentiful across the years of the ERIC database. Stone (1997) found that teacher leadership was positively correlated with years-of-teaching-experience. Klecker and Loadman (1998,1997) found no difference by years-of-teaching-experience in either teachers' ratings' of their sense of empowerment or teachers' ratings of their overall job satisfaction.

Felter (2001) found a positive relationship between teacher experience and preparation and student achievement despite the effects of student poverty. Bodenhausen (1988) found that students of teachers with more than 10 years of experience teaching advanced placement classes had higher scores on advance placement tests. Chidolue (1996) found significant positive relationships between teachers' teaching experience and student achievement in high school biology classes. Darling-Hammond (2002) summarized research on the relationship of teachers' years-of-teaching-experience with student achievement.

*Teaching Experience*. Other studies of the effects of teacher experience on student learning have found a relationship between teachers' effectiveness and their years of experience (Murnane & Phillips,

> 1981; Klitgaard & Hall, 1974), but not always a significant one or an entirely linear one. While many studies have established that inexperienced teachers (those with less than three years of experience) are typically less effective than more senior teachers, the benefits of experience appear to level off after about five years, especially in non-collegial work settings (Rosenholtz, 1986). A possible cause of this curvilinear trend in experience effects is that older teachers do not always continue to grow and learn and may grow tired in their jobs. Furthermore, the benefits of experience may interact with educational opportunities. Veteran teachers in settings that emphasize continual learning and collaboration continue to improve their performance (Rosenholtz, 1984) (Darling-Hammond, 2000, p. 6).

The purpose of this study is to continue the exploration of student achievement across teachers' years of teaching experience. The National Assessment for Educational Progress (NAEP) Mathematics Test data provide national and state-by-state scaled scores from a randomly selected student population. The questions included in the NAEP database permitted a cross-sectional analysis by years of mathematics teaching, rather than simply years of teaching experience.

*Research Question*

The research question for this study was: Are mathematics scores of students of more experienced mathematics teachers higher than those of students of less experienced teachers?

## *Methodology*

Data collection for the National Assessment for Educational Progress Mathematics Test was described by the National Center for Educational Statistics (2002a, p. 4)

### *Description of School and Student Samples*

> The NAEP 2000 mathematics assessment was conducted nationally at grades 4, 8, and 12 and state-by-state at grades 4 and 8. The national assessment included representative samples of both public and nonpublic schools. The state-by-state assessments included only public schools. In the national sample approximately 14,000 -graders, 16,000 eighth-graders, and 13,000 twelfth-graders were assessed. In the state assessments, approximately 100,000 students at each of grades 4 and 8 were assessed. The number of schools in the reporting sample were 742 at grade four, 744 at grade 8, and 558 at grade 12. Additional information about school and student samples is given in appendix A (pages 189-194).

### *Data Analysis.*

The NAEP Data Tool (National Center for Educational Statistics, 2002b) was used to create data tables from selected national and state results from the 2000 National Assessment of Educational Progress (NAEP) Mathematics Assessments for fourth and eighth grade students. The years-of-teaching-experience categorization of the data was created by choosing the NAEP question," Counting this year, how many years in total have you taught mathematics? (Include any permanent, full-time, or part-time assignments, but not substitute assignments.) (teacher-

reported)" (National Center for Educational Statistics, 2002). Thus, "years-of-teaching experience," is defined for this study as years of experience teaching mathematics.

*Statistical significance.* Alpha alpha level of .01 was used for all statistical tests. The NAEP Data Tool for "testing for statistically significant differences" was used to test observed mean scale score differences. This section of the NAEP Data Tool yielded (1) statistically significant differences between groups, (2) the mathematical difference between the means, and (2) the calculated and p. value--reported as four decimal places. Statistical significance is reported in this paper as $p. < .01$.

*Effect size.* Effect size was calculated by dividing the difference between the two mean scale scores by the average of the standard deviation of the two categorical groups and is interpreted as an effect size of .2 as small, .5 as medium, and .8 as large (Cohen, 1988). The standard deviation for each group was calculated by (1) multiplying N by the row percent of the category to find n of the category; (2) taking the square root of n (3) multiplying the square root of n times the standard error (provided).

## Results

Table 1.

*Overall Average Student Scale Scores on the 2000 Mathematics National Assessment of Educational Progress*

| NAEP Assessment | N | Average Scale Score | Standard Error |
|---|---|---|---|
| National fourth grade | 13,511 | 288 | 0.9 |
| National eighth grade | 15,694 | 275 | 0.8 |
| National Public Schools fourth grade | 7,070 | 226 | 1.0 |
| National Public Schools eighth grade | 9,353 | 274 | 0.8 |
| Kentucky fourth grade | 2,275 | 221 | 1.2 |
| Kentucky eighth grade | 2,294 | 272 | 1.4 |
| Tennessee fourth grade | 2,488 | 220 | 1.5 |
| Tennessee eighth grade | 2,232 | 263 | 1.7 |
| Texas fourth grade | 2,171 | 233 | 1.2 |
| Texas eighth grade | 2,317 | 275 | 1.5 |

Table 2.

*2000 NAEP National Mathematics Grade 4 Scores by Years of Teaching Experience*

| OVERALL PERFORMANCE | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2 years or less | | | 3-5 years | | | 6-10 years | | | 11-24 years | | | 25 years or more | | |
| N | Avg. Score | S.E. | Row Pct. | Avg. Score | S.E. | Row Pct. | Avg. Score | S.E. | Row Pct. | Avg. Score | S.E. | Row Pct. | Avg. Score | S.E. | Row Pct. |
| 11,879 | 223 | 1.7 | 12% | 224 | 2.2 | 16% | 226 | 1.4 | 18% | 227 | 1.3 | 33% | 230 | 2.4 | 21% |

Average scale scores for the national grade 4 NAEP mathematics assessment ranged from 223 to 230 across the years-of-teaching experience categories. More than half the teachers (54%) had 11 or more years of teaching experience. There were no statistically significant differences ($p<.01$) between the mean scale scores of students with teacher in the categories of years-of-teaching experience.

Table 3.

*2000 NAEP National Mathematics Grade 8 Scores by Years of Teaching Experience*

| OVERALL PERFORMANCE | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2 years or less | | | 3-5 years | | | 6-10 years | | | 11-24 years | | | 25 years or more | | |
| N | Avg. Score | S.E. | Row Pct. | Avg. Score | S.E. | Row Pct. | Avg. Score | S.E. | Row Pct. | Avg. Score | S.E. | Row Pct. | Avg. Score | S.E. | Row Pct. |
| 13,288 | 270 | 2.4 | 18% | 277 | 2.5 | 16% | 276 | 2.0 | 19% | 278 | 1.4 | 32% | 282 | 2.5 | 15% |

Average student scale scores for the national grade 8 NAEP mathematics assessment ranged from 270 to 282 across their teachers' years-of-teaching experience categories. The mean scale score of students with teachers in the 25-years-or-more category (282) was statistically significantly ($p<.01$) higher than the mean scale score students with teachers in the 2-years-or-less category (270) with an effect size of .10.

Additionally, the mean scale score students with teacher in the 11-24-years-of-teaching-experience category (278) was statistically significantly ($p<.01$) higher than the mean scale score students with teachers in the 2-years-or-less category (270) with an effect size of .08.

Table 4.

*National Public School Mathematics Grade 4 Scores by Years of Teaching Experience*

| OVERALL PERFORMANCE | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2 years or less | | | 3-5 years | | | 6-10 years | | | 11-24 years | | | 25 years or more | | |
| N | Avg. Score | S.E. | Row Pct. | Avg. Score | S.E. | Row Pct. | Avg. Score | S.E. | Row Pct. | Avg. Score | S.E. | Row Pct. | Avg. Score | S.E. | Row Pct. |
| 6083 | 221 | 2.1 | 14% | 227 | 2.8 | 17% | 225 | 1.8 | 18% | 227 | 1.5 | 32% | 230 | 2.8 | 19% |

Average student scale scores for the national public school grade 4 NAEP mathematics data ranged from 221 to 230 across their teachers' years-of-teaching experience categories. Approximately half the teachers (51%) had 11 or more years of teaching experience. There were no statistically significant differences ($p<.01$) between student scores across the categories of years-of-teaching experience.

Table 5.

*National Public School Mathematics Grade 8 Scores by Years of Teaching Experience*

| OVERALL PERFORMANCE | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2 years or less | | | 3-5 years | | | 6-10 years | | | 11-24 years | | | 25 years or more | | |
| N | Avg. Score | S.E. | Row Pct. | Avg. Score | S.E. | Row Pct. | Avg. Score | S.E. | Row Pct. | Avg. Score | S.E. | Row Pct. | Avg. Score | S.E. | Row Pct. |
| 7935 | 269 | 2.7 | 17% | 276 | 2.8 | 16% | 275 | 2.2 | 19% | 277 | 1.5 | 32% | 282 | 2.7 | 15% |

Average student scale scores for the national public school grade 8 NAEP mathematics test ranged from 269 to 282 across their teachers' years-of-teaching experience categories. The mean scale score of students of teachers with 25-years-or-more teaching experience (282) was

statistically significantly ($p<.01$) higher than the mean scale score of students of teachers with 2-years-or-less teaching experience (269) with an effect size of .14.

Additionally, the mean scale score of students with teachers with 11-24-years-of-teaching-experience (277) was statistically significantly ($p<.01$) higher than the mean scale score students of teachers with 2-years-or-less teaching experience (270) with an effect size of .08.

Table 6.

*2000 NAEP Kentucky Mathematics Grade 4 Scores by Years of Teaching Experience*

| OVERALL PERFORMANCE | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2 years or less | | | 3-5 years | | | 6-10 years | | | 11-24 years | | | 25 years or more | | |
| N | Avg. Score | S.E. | Row Pct. | Avg. Score | S.E. | Row Pct. | Avg. Score | S.E. | Row Pct. | Avg. Score | S.E. | Row Pct. | Avg. Score | S.E. | Row Pct. |
| 2,080 | 217 | 3.7 | 15% | 219 | 2.8 | 22% | 219 | 2.4 | 19% | 223 | 2.0 | 32% | 228 | 4.8 | 12% |

Average student scale scores for the Kentucky grade 4 NAEP mathematics tests ranged from 217 to 228 across the years-of-teaching experience categories. Half the Kentucky teachers (50%) had taught mathematics for 11 or more years. There were no statistically significant differences ($p<.01$) between the fourth grade students' NAEP mathematics scores by their teachers' years-of-teaching experience

Table 7.

*2000 NAEP Kentucky Mathematics Grade 8 Scores by Years of Teaching Experience*

| OVERALL PERFORMANCE | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2 years or less | | | 3-5 years | | | 6-10 years | | | 11-24 years | | | 25 years or more | | |
| N | Avg. Score | S.E. | Row Pct. | Avg. Score | S.E. | Row Pct. | Avg. Score | S.E. | Row Pct. | Avg. Score | S.E. | Row Pct. | Avg. Score | S.E. | Row Pct. |
| 2066 | 266 | 4.2 | 15% | 267 | 3.1 | 21% | 270 | 2.7 | 26% | 279 | 2.0 | 33% | 281 | 5.6 | 5% |

Average student scale scores for the Kentucky grade 8 NAEP mathematics test ranged from 266 to 281 across the years-of-teaching experience categories. The mean scale score of students of teachers with 11-24-years of teaching experience (279) was statistically significantly ($p<.01$) higher than the mean scale score of students of teachers with 2-years-or-less years of teaching experience (266) with an effect size of .21.

The mean scale score of students with teachers with 11-24 years of teaching experience (279) was also higher than the mean scale score of. students of teachers with 3-5-years-of-teaching-experience (267) with an effect size of .34, and the mean scale score of students with teachers with 6-10-years-of-teaching-experience (270) with an effect size of .16.

Table 8.

*2000 NAEP Tennessee Mathematics Grade 4 Scores by Years of Teaching Experience*

| OVERALL PERFORMANCE | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2 years or less | | | 3-5 years | | | 6-10 years | | | 11-24 years | | | 25 years or more | | |
| N | Avg. Score | S.E. | Row Pct. | Avg. Score | S.E. | Row Pct. | Avg. Score | S.E. | Row Pct. | Avg. Score | S.E. | Row Pct. | Avg. Score | S.E. | Row Pct. |
| 2397 | 214 | 3.9 | 14% | 219 | 4.3 | 14% | 223 | 3.3 | 19% | 221 | 1.9 | 38% | 221 | 3.2 | 15% |

Average student scale scores for the Tennessee fourth grade NAEP mathematics tests ranged from 214 to 223 across the years-of-teaching experience categories. Approximately half the Tennessee teachers (53%) had taught mathematics for 11 or more years. There were no statistically significant differences ($p<.01$) between the Tennessee fourth grade students' NAEP mathematics scores by their teachers' years-of-teaching experience

Table 9.

*2000 NAEP Tennessee Mathematics Grade 8 Scores by Years of Teaching Exp*

| OVERALL PERFORMANCE | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2 years or less | | | 3-5 years | | | 6-10 years | | | 11-24 years | | | 25 years or more | | |
| N | Avg. Score | S.E. | Row Pct. | Avg. Score | S.E. | Row Pct. | Avg. Score | S.E. | Row Pct. | Avg. Score | S.E. | Row Pct. | Avg. Score | S.E. | Row Pct. |
| 2076 | 254 | 5.2 | 15% | 258 | 4.0 | 16% | 264 | 2.6 | 20% | 271 | 3.2 | 31% | 268 | 7.2 | 18% |

Average student scale scores for the Tennessee eighth grade NAEP mathematics tests ranged from 254 to 271 across their teachers' years-of-teaching experience categories. Approximately half the Tennessee teachers (49%) had taught mathematics for 11 or more years. There were no statistically significant differences ($p<.01$) between the Tennessee eighth grade students' NAEP mathematics scores by their teachers' years-of-teaching mathematics experience

Table 10.

*2000 NAEP Texas Mathematics Grade 4 Scores by Years of Teaching Exp*

| OVERALL PERFORMANCE | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2 years or less | | | 3-5 years | | | 6-10 years | | | 11-24 years | | | 25 years or more | | |
| N | Avg. Score | S.E. | Row Pct. | Avg. Score | S.E. | Row Pct. | Avg. Score | S.E. | Row Pct. | Avg. Score | S.E. | Row Pct. | Avg. Score | S.E. | Row Pct. |
| 1976 | 233 | 2.4 | 15% | 230 | 2.3 | 17% | 232 | 2.1 | 20% | 236 | 1.6 | 34% | 237 | 3.2 | 14% |

Average student scale scores for the Texas fourth grade NAEP mathematics tests ranged from 233 to 237 across their teachers' years-of-teaching experience categories. Almost half the Texas teachers (48%) had taught mathematics for 11 or more years. There were no statistically significant differences ($p<.01$) between the Texas fourth grade students' NAEP mathematics scores by their teachers' years-of-teaching experience

Table 11.

*2000 NAEP Texas Mathematics Grade 8 Scores by Years of Teaching Exp*

| OVERALL PERFORMANCE | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2 years or less | | | 3-5 years | | | 6-10 years | | | 11-24 years | | | 25 years or more | | |
| N | Avg. Score | S.E. | Row Pct. | Avg. Score | S.E. | Row Pct. | Avg. Score | S.E. | Row Pct. | Avg. Score | S.E. | Row Pct. | Avg. Score | S.E. | Row Pct. |
| 2237 | 270 | 4.6 | 20% | 271 | 3.2 | 18% | 273 | 2.1 | 21% | 280 | 2.4 | 31% | 285 | 3.4 | 9% |

Average student scale scores for the Texas grade 8 NAEP mathematics test ranged from 270 to 285 across the years-of-teaching experience categories. The mean scale score of students of teachers with 11-24-years of teaching experience (280) was statistically significantly ($p<.01$) higher than the mean scale score of students of teachers with 2-years-or-less years of teaching experience (270) with an effect size of .22. The mean scale score of students with teachers who had 11-24 years of teaching experience (280) was also higher than the mean scale score of students of teacher with 3-5-years-of-teaching-experience (271) with an effect size of .14, and the mean scale score of students of teachers with 6-10-years-of-teaching-experience (273) with an effect size of .13.

The mean scale score of students' of teachers with 25-years-or-more experience teaching mathematics (285) were statistically significantly ($p.<.01$) higher than the mean scale scores of students of teachers with 2 or fewer years of teaching experience (270) with an effect size of .37, and students of teachers with 3-5-years-of-teaching experience (271) with an effect size of .35.

The mean scale score of students of teachers' with 25-years-or-more experience teaching mathematics (285) was also statistically significantly ($p.<.01$) higher than the mean scale scores of students of teachers with 6-10-years-of-experience (273) with an effect size of .39. Forty percent of Texas teachers in the NAEP sample have 11 years or more experience.

## Discussion

The research question that drives this study is: Are mathematics scores of students of more experienced mathematics teachers higher than those of students of less experienced teachers? There is not convincing evidence that there are meaningful differences among student mean scale scores on the 2000 NAEP Mathematics Test by teachers' years of experience teaching mathematics. Although statistical significance ($p.<.01$) was found between groups on the eight grade tests, the effect size of these differences are interpreted as "less than small," that is, less than .2 standard deviations or "small," that is, in the .34 to .37 range.

The lack of variation between the categories explored in this study is also a result of the lack of wide variance in the data as a whole. No causal inferences can be drawn from this study as it was limited to a secondary correlational analysis. However, the lack of variation in students' mean scaled scores across the years of mathematical teaching experience of their teachers is remarkable, especially at the state level. With on-going school reform efforts strengthening the standards for teacher preparation, perhaps the absence of lower student scores for students of the newest teachers (2-years or less) (Darling-Hammond, 2000) offers some evidence that these reforms may be working.

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